Email discussion summary for [99-e][332] NR_perf_enh2_Demod_Part3_NWM - Version 0.0.4 RAN4

1 Introduction

As per the discussion on BS PUSCH demodulation requirements for FR1 256QAM in last RAN4#98-bis-e, great progress was achieved as listed in the approved WF R4-2106120, still some open issues are left for further discussion.

1st round discussion:

Based on companies' inputs by contributions, collect companies' view on those left open issues and some new issues raised in this meeting, and try to reach some consensus.

2nd round discussion:

Try to find some way forward by certain compromise among companies.

2 Topic #1: Test parameters

2.1 Companies' contributions summary

Table 1: Companies' contribution summary

T-doc number	Company	Title	Proposals / Observations
R4-2109104	CATT	Simulation results for PUSCH 256QAM performance requirement	Simulation results

R4-2109105	CATT	Discussion on PUSCH demodulation requirements for FR1 256QAM	Proposal 1: To adopt MCS index =22 for 256QAM demodulation. Proposal 2: To adopt pos1 additional DM-RS position for 256QAM demodulation. Proposal 3: Not to configure PTRS for 256QAM demodulation. Proposal 4: To adopt Option 1: Only 1Tx for 256QAM demodulation. Proposal 5: To adopt Option 1: Only 1 layer for 256QAM demodulation. Proposal 6: To adopt Option 2: 2/4/8 Rx for 256QAM demodulation. Proposal 7: To adopt Option 1: Reuse the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1 for 256QAM demodulation. Proposal 8: To adopt 15 kHz SCS: Option 2: 5MHz, 10MHz, 20MHz and 30 kHz SCS: Option 2:10MHz, 20MHz, 40MHz, 100MHz for 256QAM demodulation. Proposal 9: To adopt Option 1: Reuse the existing applicability rules defined in sections 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1 for 256QAM demodulation. Observation 1: Additional margin due to TX EVM is dependent with MCS.

R4-2109136	China Telecom	Discussion on PUSCH FR1 256QAM demodulation requirements	Proposal 1: Cover both 1Tx 1 Layer and 2Tx 2 Layer transmission configuration for PUSCH 256QAM demodulation test requirements. Proposal 2: Reuse the same test applicability for different antenna configurations for Rel-15 PUSCH demod in clause 8.1.2.0 of TS38.141-1. Proposal 3: Cover 2/4/8 Rx antenna configurations for PUSCH 256QAM demodulation test requirements. Proposal 4: Use MCS 24 (R = 841/1024) in MCS Table 2 for NR PUSCH 256QAM test cases. Proposal 5: Only consider pos1 for the DMRS additional position. Proposal 6: Reuse the existing test applicability rule defined in clause 8.1.2.1.1 and 8.1.2.1.2 of TS38.141-1. Proposal 7: Reuse the same CBW configurations for Rel-15 PUSCH demodulation tests, i.e., option 2 for both 15kHz SCS and 30kHz SCS. Proposal 8: Not to consider PT-RS for the PUSCH 256QAM demodulation test. Proposal 9: Not to consider PN model for the PUSCH 256QAM test to align with the agreements in the WID. Proposal 10: Reuse the existing MU and TT values for PUSCH demodulation test cases defined in TS38.141-1.

R4-2109201	Intel Corporation	Discussion on PUSCH requirements for FR1 256QAM	Proposal 1: Don't consider phase noise impact for FR1 PUSCH 256QAM requirements definition. Proposal 2: Don't configure PT-RS for FR1 PUSCH 256QAM requirements definition. Proposal 3: Consider only scenario with 1 additional DMRS for FR1 PUSCH 256QAM requirements definition. Proposal 4: Consider 3.5% Tx EVM modelling for FR1 PUSCH 256QAM alignment simulation results. Proposal 5: Define FR1 PUSCH requirements with 256QAM modulation for scenarios with 1 TX antenna and 1 MIMO layer Proposal 6: Define FR1 PUSCH requirements with 256QAM modulation for scenarios with 2 and 8 receive antennas and use the following applicability rules: • BS with higher than 8 receive antennas: Reuse applicability rule in clause 8.1.2.0 of TS38.141-1. • BS with higher 4 receive antennas: Unless otherwise stated, for a BS supporting 4 antenna connectors (for BS type 1-C) or TAB connectors (for BS type 1-H), the performance requirement tests for 2 RX antennas shall apply, and the specific connectors used for testing are based on manufacturer declaration. Proposal 7: Define FR1 PUSCH requirements with 256QAM modulation for CBWs 5MHz and 10MHz for 15 kHz

R4-2109491	CMCC	Discussion on BS demodulation enhancement for FR1 256QAM	Proposal 1: For Tx, use both 1Tx and 2Tx Proposal 2: For Rx, use 2Rx, 4Rx and 8Rx Proposal 3: Use 1 layer for 1Tx and 2 layers for 2Tx. Proposal 4: For the antenna configuration applicability rule, reuse the existing test applicability rule defined in clause 8.1.2.0 of TS 38.141-1. Proposal 5: For 15kHz SCS, define 5MHz, 10MHz and 20MHz bandwidth configuration test cases. Proposal 6: For 30kHz SCS, define 10MHz, 20MHz, 40MHz and 100MHz bandwidth configuration test cases. Proposal 7: Reuse the existing applicability rules defined in clause 8.1.2.1.1 and 8.1.2.1.2 of TS38.141-1

R4-2109609	Ericsson	Discussion on PUSCH demodulation with 256QAM	Proposal 1: PUSCH demodulation performance requirements for 256QAM is defined for 2, 4 and 8 Rx antennas. Proposal 2: For different antenna configurations, the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1 is reused. Proposal 3: Only 1 layer is considered for the PUSCH demodulation performance requirements for 256QAM. Proposal 4: Only 1 Tx antenna is considered for the PUSCH demodulation performance requirements for 256QAM. Proposal 5: A small set of bandwidths for each SCS, i.e. 5/10MHz for 15kHz SCS and 10/40MHz for 30kHz SCS, can be defined for the PUSCH demodulation performance requirements for 256QAM. Proposal 6: The applicability rules for different SCS and CBW can be reused for the PUSCH demodulation performance requirements for 256QAM. Proposal 7: For 256QAM, the PUSCH demodulation performance requirements is defined based on MCS#24.
R4-2109610	Ericsson	Simulation results for PUSCH demodulation with 256QAM	Simulation results

R4-2109712	NTT DOCOMO, INC.	Views on FR1 PUSCH 256QAM	Number of Rx Observation 1: The number of Rx are 2/4/8 for PUSCH with transform precoding disabled for 64QAM. Observation 2: 4Rx is typical configuration. If there is no requirement for 4Rx, 4Rx base stations would be tested with only 2Rx based on the existing applicability rules. Proposal 1: RAN4 consider 2/4/8 as the number of Rx (Option 2). SCS and bandwidth Observation 3: 15kHz SCS for 20MHz CBW and 30kHz SCS for 100MHz CBW are also typical cases. Observation 4: A wider bandwidth requires more data to be sent at the same time, which increases the amount of processing required and increases the load compared to a narrower bandwidth. Proposal 2: For FR1 PUSCH 256QAM performance tests, RAN4 should consider the following combinations of SCS and CBW (Option 2 for both 15kHz SCS and 30kHz SCS): 15kHz SCS: 5MHz, 10MHz, 20MHz CBW 30kHz SCS: 10MHz, 20MHz, 40MHz and 100MHz CBW Applicability rule for different antenna connector Proposal 3: RAN4 reuse the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1 as an applicability rule for different antenna connector (Option 1).

R4-2109794	Samsung	View on PUSCH demodulation requirement with FR1 256QAM	Proposal 1: Only define FR1 PUSCH 256QAM requirement with DMRS configuration 1+1. Proposal 2: Only define FR1 PUSCH 256QAM requirement with 1 Tx and 1 layer Proposal 3: Only define FR1 PUSCH 256QAM requirement with 2Rx and 8Rx Proposal 4: Only define FR1 PUSCH 256QAM requirement with 5MHz and 10MHz for 15 KHz SCS, and 10MHz and 40MHz for 30 KHz SCS. Proposal 5: Reuse the existing test applicability rule defined in clause 8.1.2.0 of TS 38.141-1 for different antenna configuration, and reuse the existing test applicability rule defined in section 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1 for different SCS and BW. Proposal 6: Do not configure PTRS for PUSCH requirement with 256QAM in FR1 Proposal 7: Do not model phase noise modelling for ideal simulation results, the PN impact can be considered in the implementation margin. Observation 1: large performance degradation can be observed with considering Tx-EVM as 3.5% with MCS 24. Proposal 8: Additional margin should be considered for performance requirement derived for FR1 256QAM PUSCH

R4-2110569	Huawei, HiSilicon	Discussion on PUSCH demodulation requirements for FR1 256QAM	Proposal 1: We propose the following configurations: Number of Tx: 1. Number of Rx: 2/8Rx. Number of layer: 1. Proposal 2: We propose to define SCS and bandwidth of 10 MHz/15 kHz and 40 MHz/30 kHz for PUSCH 256QAM. Proposal 3: We propose to reuse the existing test applicability rule for different antenna configurations. Proposal 4: We propose to reuse the existing test applicability rule for different SCS and CBW. Proposal 5: We propose to use MCS22.

R4-2110593	Nokia, Nokia Shanghai Bell	On PUSCH demodulation requirements for FR1 256QAM	Concerning MCS Using MCS24 the SNR requirements are >20dB, even for the rank1 only cases. RAN4 to use MCS22 in order to keep SNR requirements within reasonable levels. Concerning DM-RS 3 DM-RS (i.e., addPos=2) does not offer signification performance improvements over 2 DM-RS but reduces absolute TPUT. RAN4 to only have requirements for DM-Rs 1+1 (addPos=1). Concerning PT-RS Phase noise has a limited impact on 256QAM FR1 performance (<0.3dB for all tested cases). The "puncturing losses" from configuring PT-RS configuration (K=2, L=1) overwhelm the gains from PN compensation. RAN4 to not configure PT-RS in FR1 256QAM. Phase noise impact consideration and Tx EVM RAN4 to take PN models into account for final impaired results. A 3.5% EVM limits the max achievable SNR to approx. 29.1dB, but has little performance impact below this threshold, which is not in line with the PN performance impact observed in our simulations. RAN4 to not use Tx-EVM to approximate PN. Concerning layers Using 2 layers increases the SNR requirements up to 36 dB and 32dB, for MCS 24 and MCS22 respectively RAN4 to not cover 2 layer requirements to

R4-2110594	Nokia, Nokia Shanghai Bell	Simulation results for PUSCH demodulation requirements for FR1 256QAM	Simulation results
R4-2110994	ZTE Wistron Telecom AB	Demodulation performance requirements for NR PUSCH 256QAM	Proposal 1: Take Option 2 for the number of Tx in order to include 2Tx configuration. Proposal 2: Take Option 2 for the number of Rx, number of layers, SCS and bandwidth. Proposal 3: Take Option 1 to reuse existing applicability rules for antenna configurations and SCS and CBW.

2.2 Open issues summary

2.2.1 MCS

Background: The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:

MCS: Evaluate {MCS24, MCS22} as starting point for next meeting, based on the simulation results to decide if MCS24 is feasible, otherwise to check lower MCS22 is feasible or not.

Proposals

- Option 1: MCS 22 (CATT, Huawei, Nokia)

- Option 2: MCS 24 (CTC, Ericsson)

Recommended WF

o Both conducted and radiated performance requirements need to be defined as per the existing requirements for other modulation orders for 2Rx, testable SNR point (20dB) for OTA test needs to be considered?

o For conducted test, how to judge a reasonable and testable SNR point?

Feedback Form 1: Issue 1: MCS

1 – Samsung Electronics Benelux BV

Samsung:

Based on our initial results, the SNR of 70% TP with MCS22 is close to 20dB for 2Rx configuration, while with MCS24 is higher than 20dB. if considering impairment margin, the SNR will be higher then 20dB.

The OTA testabilty issue need to be checked with TE vendor for BS type 1-O, whether it can be tested in Rel-17. Therefore, to guarantee the defined requiremnt can be tested, low MCS order is prefered. Smaller than MCS 22 is prefered. If there is no testability issue comfirmed by TE vendor, we are also fine with option 1
2 – CATT Option 1. Based on our initial results, the maximum SNR for MCS24 is 31.26 that is much higher than 21.4dB for E-UTRA. Such a high SNR value for MCS24 is not feasible.
3 – HiSilicon Technologies Co. Ltd Huawei: Option 1. Based on our simulation results, the SNR value at 70%TP for MCS22 with 2Rx is just smaller than 20dB. MCS24 is not feasible.
4 – Ericsson Inc. Ericsson: We also agree with option 1 considering 20dB SNR limit.
5 – Nokia Nokia: We observed in our simulations that using MCS24 the SNR requirements are >20dB, even for the rank1 only cases. Hence we maintain support for option 1.
6 – China Telecommunications We prefer option 2. It is not clear for us why we need to consider 20dB SNR limitation for this conducted performance testing. For LTE 256QAM PUSCH test, similar code rate of 5/6 is used, and we have already defined SNR requirement of 22.0dB in LTE 1T2R test cases.
7 – ZTE Wistron Telecom AB Option 1 if considering testable SNRs.

2.2.2 Additional DM-RS

Background: The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:

Additional DM-RS (dmrsAdditionalPosition): pos1, FFS pos2

Decide based on interesting companies' feedback for next meeting

Proposals

- Option 1: pos1 (CATT, CTC, Intel, Samsung, Nokia)

- Option 2: pos1 and pos2 ()

Recommended WF

As per inputs, pos1 for additional DMRS configuration is agreeable.

Feedback Form 2: Issue 2: Additional DM-RS configuration

1 – Samsung Electronics Benelux BV Samsung: We are fine with option 1
2 – CATT Option 1. We don't see the obvious performance gain (maximum 0.71dB) for DMRS 1+1+1 compared with DMRS 1+1 based on simulation results.
3 – HiSilicon Technologies Co. Ltd option 1 only.
4 – NTT DOCOMO INC. We are fine with option 1.
5 – Ericsson Inc. Ericsson: We agree with Option 1.
6 – Nokia Nokia: We observed that 3 DM-RS (i.e., addPos=2) does not offer signification performance improvements over 2 DM-RS but reduces absolute TPUT. Hence we are fine with option 1.
7 – China Telecommunications We support Option 1.
8 – ZTE Wistron Telecom AB Fine with Option 1.

2.2.3 PT-RS configuration

Background: The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:

PT-RS configuration: FFS configure PT-RS.

Further discuss and decide whether to configure PT-RS or not based on feedback from interesting companies in next meeting.

Proposals

- Option 1: Not configure PT-RS (CATT, CTC, Intel, Samsung, Nokia)

Recommended WF

As per inputs, not configure PT-RS is agreeable.

Feedback Form 3: Issue 3: PT-RS configuration

1 – Samsung Electronics Benelux BV Samsung: we are fine with option 1 and recommended WF
2 – CATT We are OK with the recommended WF.
3 – HiSilicon Technologies Co. Ltd We support the recommended WF.
4 – NTT DOCOMO INC. We are fine with the recommended WF.
5 – Ericsson Inc. Ericsson: We agree with Option 1 and WF.
6 – Nokia Nokia: As per our simulations phase noise has a limited impact on 256QAM FR1 performance (<0.3dB for all tested cases). The "puncturing losses" from configuring PT-RS configuration (K=2, L=1) overwhelm the gains from PN compensation. I.e., the proposed WF is fine for us.
7 – China Telecommunications Support the recommended WF.
8 – China Mobile Com. Corporation Support the recommended WF.
9 – ZTE Wistron Telecom AB Fine with the recommended WF.

2.2.4 Phase noise modelling

Background: The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:

Phase Noise modelling:

Realistic phase noise modelling is left up to the contributing entities.

FFS how to consider phase noise impact based on further discussion and evaluations.

Interesting company is welcome to do investigation on the PN impact on 256QAM performance for next meeting.

Proposals

- Option 1: Not consider phase noise impact for performance requirement definition (CTC, Intel)

- Option 2: Consider PN impact for final impaired results (Samsung, Nokia)

Recommended WF

As per companies' evaluation, phase noise has very minor performance impact for FR1 PUSCH 256QAM, recommend not to consider it for performance requirement definition. Whether consider it in the impairment results, it is up to company?

Feedback Form 4: Issue 4: Phase noise modelling

1 – Intel Corporation SAS We think that it is not precluded if each companies include possible PN impact in their impairment results. We think that at least for alignment results explicit PN modeling is not required.
2 – Samsung Electronics Benelux BV Samsung: How to modelling phase noise explicitly, it should be implementation issue. In Rel-15, RAN4 has the similar discussion for FR2 phase noise modelling for PUSCH requirement, where there is no phase noise modelling for alignment results. The phase noise degradation on performance will be considered in the implementation margin when companies submit their impaired results. Same approach can be applied
3 – CATT Option 1. Same view with Samsung. Phase noise impact can be considered in implementation margin.
4 – HiSilicon Technologies Co. Ltd We support the recommened WF.
5 – Ericsson Inc. Ericsson: We agree with WF.
6 – Nokia Nokia: We should follow the R15 newRAT Demod approach, where PN modelling was up to companies, but required to be included in the impaired results. If there is not much impact (in our sims <0.3dB) then that is how it is.
7 – China Telecommunications Not to consider phase noise impact for performance requirement definition, since PN modeling is left up to companies.

8 – China Mobile Com. Corporation

We agree with the recommended WF.

9 – ZTE Wistron Telecom AB

We are fine with the recommended WF. Phase noise impact is covered by the impairment margin.

2.2.5 Tx EVM

Background: The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:

Tx EVM:

Interesting companies are welcome to check the performance difference with and without Tx EVM (3.5% as baseline) impact considered.

RAN4 will discuss and decide whether additional margin should be considered in alignment results if no Tx EVM modelling in next meeting as per the evaluations results.

Proposals

- Option 1: Consider 3.5%Tx EVM modelling for alignment results (Intel)

- Option 2: Consider Tx EVM impact by additional margin for performance requirement derivation (Samsung)

- Option 3: Not use TxEVM to approximate PN (Nokia)

Recommended WF

TBD

Feedback Form 5: Issue 5: Tx EVM

1 – Intel Corporation SAS

Based on our understanding, Tx EVM should be taken into account for requirements definition because it has impact on performance for such high order modulation and we can not assume generation of ideal signal (without RF imperfections) on TE side. For UE requirements, modeling of 3% Tx EVM is used for requirement definition. Therefore, we suggest to consider such assumptions.

2 – Samsung Electronics Benelux BV

Samsung:

With high modulation, the achievable SNR is very high, which means large transmission power should be considered to fulfill the acceptable performance. In this condition, the nonlinearity of RF unit, such as PA, may result in distortion of transmission power. Therefore, the impact of Tx EVM may need to be considered. As show in our initial simulation results, there is a large performance degradation due to the impact of Tx EVM. Therefore, we think the impact of Tx should be considered. For alignment results, we may not need to modeling Tx EVM. While for performance requirement derivation, we propose to add

additional margin on top of the average impairement results of companies to consider the impact of Tx EVM.
3 – Nokia Nokia: According to our analysis in [R4-2110593] the 3.5% EVM is only starting to influence the TPUT once we get close to 30dB SNR. As long as we stay below 25dB there is no discernible influence (summation of independent noise sources is fully dominated by AWGN). If companies want to model PN with TxEVM then that is possible following our discussion in 2.2.6. It just needs to be reflected in the impaired SNR values that are delivered. Hence we want to propose to not define how PN/EVM is taken into account. Just require that it is included in the impaired results.
4 – China Telecommunications We prefer not to consider Tx EVM, which is aligned with other Rel-15 PUSCH assumptions.
5 – ZTE Wistron Telecom AB Actually even in Rel-16, there are SNR values close to 20dB, and if the expected working point for 256QAM still within the limit, then it should be fine with the conventional way for defining demodulation performance requirements. We don't see the need to have a change.
6 – Ericsson Inc. Ericsson: We share the same view as ZTE that the Tx EVM impact should not be an issue if the target SNR is just 20dB or less.

2.2.6 Number of Tx, Rx and layer

Background: The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:

Number of Tx:

- *Option 1: Only 1Tx*

- *Option 2: Both 1Tx and 2Tx*

Number of Rx:

- *Option 1: 2/8 Rx*

- *Option 2: 2/4/8 Rx*

Number of layers:

- *Option 1: Only 1 layer*

- *Option 2: Both of 1 and 2 layers*

Applicability rule for different antenna configurations

- *Option 1: Reuse the existing test applicability rule defined in clause 8.1.2.0 of TS 38.141-1*

- *Other options*

Issue 6: Number of Tx

Proposals

- Option 1: Only 1Tx (CATT, Intel,Ericsson, Samsung, Huawei)

- Option 2: Both 1Tx and 2Tx (CTC, CMCC, Nokia, ZTE)

Recommended WF

TBD

Issue 7: Number of layer

Proposals

- Option 1: Only 1 layer (CATT, Intel, Ericsson, Samsung, Huawei, Nokia)

- Option 2: Both 1 layer and 2 layers (CTC, CMCC, ZTE)

Recommended WF

Moderator's observation: as per the evaluations shared by one company (R4-2110593), very high SNR is required for 2 layers.

Issue 8: Number of Rx

Proposals

- Option 1: 2/8 Rx (Intel, Samsung, Huawei)

- Option 2: 2/4/8 Rx (CATT, CTC, CMCC, Ericsson, DCM, Nokia, ZTE)

Recommended WF

Moderator's observation:

- There is very huge simulation campion conducted for NR Rel-15 performance requirements for different CBW/SCS combinations, 1Tx/2Tx, 2/4/8Rx, PUSCH mapping Type A/B, different MCS 4/16/20, about several hundreds of simulation results. If companies carefully check the existing requirements defined in TS 38.104, there is minor performance difference for different CBW/SCS.

- Only performance requirements for typical CBW/SCS combinations are defined for NR UE demodulation requirements

- The total simulation efforts will be PUSCH mapping Type A/B, 1Tx/2Tx, 2/4/8Rx, 1layer/2layers, 5/10/20MHz/15kHz SCS, 10/20/40/100MHz/30kHz SCS, 216 simulation cases for one MCS, very heavy simulation burden for all companies?

Feedback Form 6: Issue 6/7/8: Number of Tx, Rx and Layer

1 – Intel Corporation SAS

As for number of Tx antennas and number of MIMO layers, we think that from test coverage point of view it is sufficient to cover scenario with 1 Tx and 1 layer. Also, such configuration allows to have reasonable SNR conditions for testing.

As for number of Rx antennas, we proposed 2 and 8 Rx to reduce simulation work load. Same time, we don't have strong concern to consider 2/4/8 Rx configuration.

2 – Samsung Electronics Benelux BV

Samsung

For number of Tx, scheduling 256 QAM transmission with rank2 is not a typical scenario, which will increase the achievable SNR due to the interference coming from 2 layers.

In Rel-15 BS demodulation requirement, only define 64QAM with 1 Tx configuration. It is not proper to enable 2Tx with 256QAM transmission, while 1Tx with 64QAM transmission in the real field test.

Therefore, we think 1Tx and 1 layer can fullfil the test purpose of 256QAM transmission.

Regarding the number of Rx, different with Rel-15, the test coverage of basic test should be considered. While for 256QAM transmission, we think 2Rx and 8Rx can fullfil the test purpose, meanwhile, 2Rx and 8Rx requirement can also be guaranteed to be tested based on existing test applicability rule as

Unless otherwise stated, for a BS supporting different numbers of antenna connectors (for *BS type 1-C*) or *TAB connectors* (for *BS type 1-H*) (see D.37 in table 4.6-1), the tests with low MIMO correlation level shall apply only for the lowest and highest numbers of supported connectors, and the specific connectors used for testing are based on manufacturer declaration.

Therefore, there is no necessary to introduce requirement with 2/4/8Rx, additional test effort and simulation effort are needed.

3 – CATT

For Tx number and layer, 1Tx and 1 layer is more typical than 2Tx and 2 layer and sufficient to meet the test purpose.

For Rx number, 2/4/8Rx is preferred.

4 – HiSilicon Technologies Co. Ltd

We support only define 1 layer.

For Rx number, the test purpose can be covered with the help of applicability rule. To reduce the simulation work, we support 2/8 Rx.

5 – NTT DOCOMO INC.

In terms of the number of Rx, we prefer 2/4/8 Rx aligned with Rel-15.

6 – Ericsson Inc.

Ericsson

For Tx and layer, agree with Samsung that 1Tx and 1 layer is more typical scenario for 256QAM. The 2 layer performance can't be feasible considering very high SNR and very critical orthogonal propagation path between layers.

For Rx, 2/4/8 would be better for requirement. If only 2/8 Rx are defined, but a BS declare to support 2/4Rx, then 4Rx will have no requirement according to current applicability rule.

7 – Nokia

Nokia:

Issue 6: Number of Tx

To keep SNR values as low as possible it is helpful to use as many Tx branches as possible. In this case "2". In Rel-15/64QAM we were able to get sufficiently low SNR values with 1Tx, but for 256QAM this does not seem feasible anymore. Also 256QAM devices can be expect to be more advanced than 64QAM devices. => option 2

Issue 7: Number of layer

Using 2 layers increases the SNR requirements up to 36 dB and 32dB, for MCS 24 and MCS22 respectively. Hence it is not feasible to use 2 layers. => option 1.

Issue 8: Number of Rx

Similar to the number of Tx, the number of Rx is also useful to reduce the required SNR values. Assuming that the R15/16 applicability rules remain, we don't see an issue with allowing all 2/4/8 options for number of Rx; the number of tests does not increase => option 2

8 – China Telecommunications

Considering the majoritie's view, we can compromise to only consider 1Tx and 1layer transmission. And for the number of Rx, we support option 2.

We have covered 2/4/8 Rx with test applicability for Rel-15, we do not see the need to only cover 2/8 Rx for 256QAM.

9 – China Mobile Com. Corporation

We prefer to reuse the R-15 configuration for both Tx and Rx.

For the sake of progress and simulation effort, we can compromise to only consider 1 Tx.

10 – ZTE Wistron Telecom AB

For 2 layers, the SNR figures cited here seems for only 2Rx, and SNR should be reduced if increasing Rx branches from 2Rx to 8Rx. However, we support the consideration to reduce the required simulation efforts, and it is acceptable to us to have 1Tx (1 layer) and 2/4/8 Rx.

2.2.7 Applicability rules for different antenna configurations

Proposals

- Option 1: Reusing the existing test applicability rule defined in *cl*ause 8.1.2.0 of TS38.141-1 with 2/4/8 Rx agreed. (CATT, CTC, CMCC, Ericsson, DCM, ZTE)

- Option 2: Reusing the existing test applicability rule defined in *cl*ause 8.1.2.0 of TS38.141-1 with 2/8 Rx agreed. (Samsung, Huawei)

- Option 3: (Intel) with 2/8 Rx agreed,

BS with higher than 8 receive antennas: Reuse applicability rule in clause 8.1.2.0 of TS38.141-1.

BS with higher 4 receive antennas: Unless otherwise stated, for a BS supporting 4 antenna connectors (for BS type 1-C) or TAB connectors (for BS type 1-H), the performance requirement tests for 2 RX antennas shall apply, and the specific connectors used for testing are based on manufacturer declaration.

Recommended WF

Discuss this open issue after Issue 6/7/8 are concluded

Feedback Form 7: Issue 9: Applicability rules for different antenna configuration

1 – China Telecommunications Option 1.
2 – ZTE Wistron Telecom AB Option 1.

2.2.8 SCS and bandwidth

Background: *The agreement in last RAN4#98-bis-e as captured in the approved WF R4-2106120:*

SCS and bandwidth

15kHz SCS:

- Option 1:5MHz and 10MHz

- Option 2: 5MHz, 10MHz and 20MHz.

30kHz SCS

- Option 1:10MHz and 40MHz

- Option 2:10MHz, 20MHz, 40MHz and 100MHz.

Applicability rules for different SCS and CBW

- Option 1: Reuse the existing applicability rules defined in sections 8.1.2.1.1 and 8.1.2.1.2 of TS 38.141-1

- Other options

Proposals

15kHz SCS:

- Option 1: 5MHz and 10MHz (Intel, Ericsson, Samsung, Huawei)

- Option 2: 5MHz, 10MHz and 20MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)

30kHz SCS:

- Option 1: 10MHz and 40MHz (Intel, Ericsson, Samsung, Huawei)

- Option 2: 10MHz, 20MHz, 40MHz and 100MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE)

Recommended WF

TBD

Feedback Form 8: Issue 10: SCS and bandwidth

1 – Intel Corporation SAS We think that definition of requirements for two CBWs per SCS is sufficient from test coverage point of view. Rel-15 requirements already cover different CBWs with full RB allocation. The main purpose of this test is to verify 256QAM UL processing and not to check performance for different channel bandwidths.
2 – Samsung Electronics Benelux BV Samsung Regarding the requirement of different SCS and CBW, RAN4 has specified different SCS and BW configuration for the basic NR test. From the baseband process and performance perspective, the different is very minor. The test purpose is not verify the performance of different bandwidths. Based on the applicable rule defined in Rel-15, we think only define the minimum CBW requirement can fulfill the test purpose. For test coverage purpose, the typical CBW configuration can be considered as 10MHz for 15 KHz SCS, and 40MHz for 30 KHz SCS. Therefore, we prefer to only define FR1 PUSCH 256QAM requirement with 5MHz and 10MHz for 15 KHz SCS, and 10MHz and 40MHz for 30 KHz SCS.
3 – CATT If SCS/CBW combinations for 256QAM are different from other modulations, the closest channel bandwidth lower than widest supported bandwidth for 256QAM testing will be different from that for other modulations for some widest supported bandwidth. From this perfective, option 2 for both 15kHz and 30kHz is preferred.
4 – HiSilicon Technologies Co. Ltd We support only define the typical CBW configurations: 10MHz for 15kHz and 40MHz for 30kHz. By considering the exiting applicability rule, we can comprimise to add the minimum CBW: 5MHz for 15kHz and 10MHz for 30kHz.
5 – NTT DOCOMO INC. We prefer option 2 for both 15kHz and 30kHz SCS. We have similar view with CATT, from the test condition point of view, the combination of SCS and CBW should align among each modulations. In addition, RAN4 has already narrowed it down to this combination in Rel-15.

6 – Ericsson Inc. Ericsson: We prefer Option 1. We don't see too much performance difference between bandwidths based on our simulation results, so we think less bandwidth requirements could be enough.
7 – Nokia Nokia: We don't see an issue in including more diverse CBWs for the requirements; the test effort is not impacted as every CBW declared to be supported will need to be tested in any case. However we are flexible for most options, as long as the minimum CBWs and one more practical CBW is included.
8 – China Telecommunications We support option 2 for each SCS. Test requirements for 256QAM should cover each CBW that have been covered for Rel-15 test cases for other modulation orders. Moreover, with the agreed test applicability for different CBW that limits the total test case, we do not see the need to make any down-selection. For option 1, if BS declares to support 100MHz for 30k SCS it is not enough to test 40MHz instead.
9 – China Mobile Com. Corporation Share similar view with CATT and China Telecom, Option 2 for both 15kHz SCS and 30kHz SCS.
10 – ZTE Wistron Telecom AB Share similar view as Nokia, and we can compromise to the CBW sets consisting of minimum CBW and one typical CBW.

2.2.9 Applicability rules for different SCS and bandwith

Proposals

- Option 1: Reuse the existing applicability rules defined in 8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1 (CATT, CTC, Intel, CMCC, Ericsson, DCM, Samsung, Huawei, ZTE)

Recommended WF

Moderator's observation: either options for different SCS and CBW are agreed, the existing applicability rule can be reused.

Feedback Form 9: Issue 11□Applicability rules for different SCS and bandwidth

1 – Samsung Electronics Benelux BV Samsung We are fine with option 1 and recommended WF

2 – HiSilicon Technologies Co. Ltd We support the recommended WF.
3 – Ericsson Inc. Ericsson: Agree with WF.
4 – Nokia Nokia: Agree with WF.
5 – China Telecommunications Agree with WF.
6 – China Mobile Com. Corporation OK with the recommended WF
7 – ZTE Wistron Telecom AB We are fine with the recommended WF.

2.2.10 MU and TT

Proposals

- Option 1: Reuse the existing MU and TT values for PUSCH demodulation test cases defined in TS 38.141-1 (CTC)

Recommended WF

How about the MU and TT for tests in TS 38.141-2 if radiated tests are agreed to define? reuse the existing MU and TT values in TS 38.141-2?

Feedback Form 10: Issue 12: MU and TT

1 – Samsung Electronics Benelux BV Samsung We are fine with option 1. Meanwhile, the input of TE vendor is highly appreciated
2 – CATT Support option 1.
3 – HiSilicon Technologies Co. Ltd Support option 1.

4 – Ericsson Inc. Ericsson: We are fine with Option 1.
5 – Nokia Nokia: Support option 1, but values should be in [] first for TE vendors to have time to check.
6 – China Telecommunications Option 1.
7 – ZTE Wistron Telecom AB We are fine with Option 1.

2.2.11 Performance requirements for FDD and TDD with different TDD patterns

Proposals

- Option 1: The difference between the aligned TDD patterns and FDD, in terms of performance requirements, is negligible. One set of performance requirements can be defined for FDD and TDD with different TDD patterns. (Nokia)

Recommended WF

Moderator: based on the evaluation from Nokia in this meeting and the similar evaluations for other modulation orders did for NR Rel-15, this is feasible.

Feedback Form 11: Issue 13: Performance requirements for FDD and TDD with different TDD patterns

1 – Intel Corporation SAS Support Option 1
2 – Samsung Electronics Benelux BV Samsung We are fine with option 1
3 – CATT Support option 1.
4 – HiSilicon Technologies Co. Ltd Support option 1.
5 – NTT DOCOMO INC. Support option 1.

6 – Ericsson Inc. Ericsson: We agree with Option 1.
7 – Nokia Nokia: Still agree with option 1.
8 – China Telecommunications Ok with option 1, which is aligned with the approach for Rel-15 test cases.
9 – ZTE Wistron Telecom AB We are fine with Option 1.

2.3 Summary for 1st round

Table 2: Summary for 1st round

Sub-topic#	**Status summary**
Sub-topic #1: MCS	*Tentative agreements: None* *Candidate options:* Option 1: MCS 22 (Samsung, CATT, Huawei, Nokia, Ericsson, ZTE) Option 2: MCS 24 (CTC) Option 3: MCS 20 or MCS 21 if there is testability issue for OTA test (Samsung) *Recommendations for 2nd round: Continue discussion in the 2nd round* *Whether both conducted and OTA testing need to be considered? One company commented to consider conducted testing only like LTE did* *If consider OTA testing, what is the feasible SNR point for BS type 1-O testing in Rel-17, still 20dB like agreed for NR Rel-15 BS performance requirements? TE vendors' feedback is needed.*
Sub-topic #2: Additional DM-RS	*Tentative agreements: all interesting companies are OK to only consider additional DM-RS configuration pos1 (i.e. DM-RS 1+1)* *Pos1*
Sub-topic #3: PT-RS configuration	*Tentative agreements:* Not configure PT-RS

Sub-topic #4: Phase Noise modelling	*Tentative agreements:* *Not consider explicit phase noise modelling in the alignment results.* *The phase noise impact can be included in the impairment results, but it is left up to companies.*
Sub-topic #5: Tx EVM	*Tentative agreements: None* *Candidate options:* Option 1: Consider 3.5%Tx EVM modelling for alignment results (Intel) Option 2: Consider Tx EVM impact in the impairment results Option 2a: add a certain margin on top of the averaged impairment results (Samsung) Option 2b: consider it in the impaired results submitted by companies (Nokia) Option 3: Not consider Tx EVM impact if the target SNR is 20dB or less (CTC, ZTE, Ericsson) *Recommendations for 2nd round:* *Continue discussion in the 2nd round* *As per Option 3, this issue discussion is related to the MCS and the target SNR value.*
Sub-topic #6: Number of Tx, Rx and layer, the corresponding test applicability rule	*Tentative agreements:* Number of layer: Only 1 layer *Candidate options:* Number of Tx - Option 1: Only 1Tx (CATT, Intel, Ericsson, Samsung, Huawei, CTC, CMCC, ZTE) - Option 2: Both 1Tx and 2Tx (Nokia□ Issue 8: Number of Rx - Option 1: 2/8 Rx (Intel, Samsung, Huawei) - Option 2: 2/4/8 Rx (CATT, CTC, CMCC, Ericsson, DCM, Nokia, ZTE, Intel) *Recommendations for 2nd round:* As per the first discussion and based on majority's view, moderator would like to propose the following way forward, it can be confirmed by companies in the 2nd round discussion: Number of Tx: Only 1Tx Number of Rx: 2/4/8 with reusing the existing test applicability rule for testing of supported different number of Rx antenna

Sub-topic #7: SCS and bandwidth and test applicability rule	*Tentative agreements:* Reuse the existing applicability rules defined in 8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1 for different SCS and bandwidth combination. *Candidate options:* 15kHz SCS: - Option 1: 5MHz and 10MHz (Intel, Ericsson, Samsung, Huawei, Nokia, ZTE) - Option 2: 5MHz, 10MHz and 20MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE) 30kHz SCS: - Option 1: 10MHz and 40MHz (Intel, Ericsson, Samsung, Huawei, Nokia, ZTE) - Option 2: 10MHz, 20MHz, 40MHz and 100MHz (CATT, CTC, CMCC, DCM, Nokia, ZTE) *Recommendations for 2nd round:* *Continue discussion in the 2nd round* *Companies are welcome to check the performance difference for different channel bandwidths defined for NR Rel-15* *Simulation burden can be considered by companies for the sake of progress*
Sub-topic #8: MU and TT	*Tentative agreements:* Reuse the existing MU and TT values for PUSCH demodulation test cases defined in TS 38.141-1, but with square brackets for TE vendors' checking. *Candidate options: None* *Recommendations for 2nd round: None*
Sub-topic #9: Performance requirements for FDD and TDD with different TDD patterns	*Tentative agreements:* One set of performance requirements can be defined for FDD and TDD with different TDD patterns. *Candidate options: None* *Recommendations for 2nd round: None*

3 Recommendations for Tdocs

3.1 1st round

New tdocs

Table 3: New tdocs after 1st round discussion

Title	Source	Comments

WF on FR1 PUSCH 256QAM performance requirements	Huawei, HiSilicon	